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An expert advisory system for the ISO 9001 quality system

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Abstract

The ISO 9000 quality management system has been widely accepted and adapted as a national standard by most industrial countries. Despite its high popularity and the urgent demand from customers to implement ISO 9000, some major concerns for those organizations that are seeking registration to ISO 9000 include the expensive cost and the lengthy time to implement.

The purpose of this paper is to describe an expert advisory system for ISO 9001 implementation by using an expert system shell called Visual Rules Studio. This expert advisory system integrated the ISO 9001 quality system guidelines and an evaluation approach based on the Malcolm Baldrige National Quality Award (MBNQA) criteria into a knowledge-based expert system. By identifying the critical ISO elements and comparing the company's current quality performance with ISO standards, this advisory system provides assessment results and implementation suggestions to the organization. The advisory system has been validated by a group of quality professionals. The following contains a description of the system and a discussion of the validation results. Limitations of the system and recommendations for future research are also discussed.

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1. Introduction

In recent years, the quality of manufacturing products has become one of the most important factors that influence national and international business and economic patterns. Numerous quality standards have been developed and adopted over the years, with the ISO family of standards representing an international consensus on good management practices with the aim of ensuring that the organization can deliver the products or services that meet the client's quality requirements. The American National Standards Institute has adopted the ISO 9000 series as national standard Q 9000. The US Department of Defense developed MIL-HDBK-9000 based on the international standards (Marash, 1994). Federal agencies such as NASA, the Federal Aviation Administration, and Food and Drug Administration have integrated the ISO 9000 standards into their contractual requirements (Karon, 1996; Miller, 1993). The Big Three automakers and some truck manufacturers have created common quality system requirements for their suppliers, known as QS-9000 (Struebing, 1996).

QS-9000 incorporates all twenty elements of ISO 9001 with industry requirements. Today, the ISO 9000 quality management system are being used by many companies and organizations as a foundation for total quality management (TQM). The standards give organizations guidelines on what constitutes effective quality management and models against which this system can be audited to give the organization and its client's assurance that they are operating effectively. In the United States, a growing number of companies are seeking registration. The number of ISO 9000 registrations grew steadily from 885 in 1992 to 35,018 in 2000 (DeMarco, 1995; ISO, 2001).

This paper describes an expert advisory system designed to help organizations in their pursuing of ISO 9000 implementation. By identifying all the critical ISO elements and comparing a company's current quality system with ISO standards, the advisory system will provide assessment results and implementation suggestions to the company. The advisory system has two main goals. First, integrate the ISO 9001 quality system guidelines and an evaluation approach based on the Malcolm Baldrige National Quality Award (MBNQA) criteria. Second, utilize these ISO-Baldrige criteria to develop a knowledge-based expert system.

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2. Brief overview of ISO 9000

Since 1987, the ISO 9000 standards series was published by the International Organization for Standardization (ISO). It has quickly been adopted by many nations and regional bodies and is rapidly supplanting prior national and industry-based standards. In America, many government agencies have adopted ISO 9000 and dropped long-standing quality standards. More importantly, the European Community (now European Union) chose ISO 9000 to consolidate the varying technical norms of its member states in 1989. ISO compliance became part of hundreds of product safety laws throughout Europe, regulating everything from medical devices to telecommunications gear. Suddenly, ISO 9000 registration has become a necessity for a company to do business freely in Europe. To qualify as an ISO 9000 registered company, a firm must prove to the ISO auditors that its management, design, manufacturing, test operations and services are at an optimum level of quality, allowing it to instill confidence in customers that it can sustain such quality.

A company seeking ISO 9000 registration begins by establishing contact with an accredited registration body (a registrar). The registrar evaluates the company's quality manual and on-site practices to confirm that the company's quality system conforms to the standards and is consistent with its own documentation. If these assessments find no serious inconsistencies, the company is granted ISO 9000 registration. Surveillance audits are conducted after registration is granted (ISO, 1996). Despite of enormous benefits of registrations, there are several concerns associated with ISO 9000 implementation. The cost of setting up and the drain on management time for ISO 9000 registration can become a significant hurdle to overcome for a small to mid-size companies. With fewer internal resources, the ISO 9000 series standards are very difficult for smaller companies to adopt.

3. Advantages of ISO 9000 registration

Notwithstanding the substantial cost, many companies are committing their organizations to achieving registration because of the perceived advantages:

- *Access to market.* The registration enables a company to maintain or even create new customers where ISO 9000 registration is required. The European Community Council has mandated ISO 9000 registration for companies manufacturing commercial scales, construction products, gas appliances, industrial safety equipment, and medical devices.
- *Customer demand.* The pressure to attain ISO 9000 registration may come from customers. Many customers worldwide require or expect their suppliers to be ISO 9000 registered. The 1996 quality system updated (QSU)

survey reported that 83% of responding companies were encouraging or considering some or all their suppliers to seek ISO 9000 registration (Meyer, 1998).

- *Improve company's quality system.* Most ISO registered companies take the standards as a foundation for building a good quality system. Similar to the Baldrige criteria, ISO 9000 also has an emphasis on continuous quality improvement by audit and surveillance through a third-party auditor. Many ISO registered companies have reported improvement and cost reduction after they adopted ISO 9000. The 1996 QSU survey showed that 95% of respondents had derived internal benefits, with 83% citing higher quality awareness among workers.
- Other advantages exist such as developing self-discipline, worldwide recognition, improving overall competitiveness, enhancing marketing credibility, serving as a global quality model, avoiding duplicative quality audits, and creating uniform quality system (Hutchins, 1997).

The Baldrige Award. The Baldrige award criteria were developed in the late 1980s and have been used by a growing number of organizations as a self-assessment tool for evaluating TQM performance (Wu Wiebe, & Politi, 1997). Today, more than 43 states in the United States have established quality awards using Baldrige as a model. Countries such as Japan, Argentina, and Australia have developed quality awards that reflect the Baldrige model (George, 2002; Steeples, 1994).

A large number of companies doing international business have used the Malcolm Baldrige National Quality Award Criteria and ISO 9000 as tools to achieve TQM. To the compare the two systems, Curkovic and Handfield (1996) present an ISO and Baldrige predicted matrix to show the relationship of these two systems, highlighting major Baldrige Award criteria that are not included in ISO 9000 requirements. Grant and Leavenworth (1996) compared ISO 9000 requirements with Baldrige criteria and listed both common and unique items for these systems, finding the most of the Baldrige award criteria are contained in the ISO 9000 standards. An analysis of the relationship between ISO 9001-1987 and the 1993 Baldrige award criteria were conducted by the AT&T quality group (AT&T quality group, 1995). In general, almost every element in ISO 9001 has some kind of linkage with the Baldrige criteria. The only element of ISO 9001 with no linkage is the Document Control. The comparison made by Stephens (1997) indicates reasonable harmony between two systems. To this end, both the ISO 9000 and Baldrige requirements were used for developing the expert system advisory system.

4. Introduction to expert system

As computers have swept the modern world, expert systems have been applied in a wide variety of domains

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